

Department of Computer and Mathematical Sciences, University of Toronto
MATA02 – The Magic of Numbers

Syllabus—Winter 2022
January 05, 2022

Instructor: Yun William Yu

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For general course questions that other students might also have, please use Piazza.

For specific questions pertaining only to you, you should email me. When you email me, please write “[MATA02]” in the start of the subject line, to minimize the chance I miss your message—I get a lot of emails, and if you don’t include the prefix, there’s a chance the email will get lost. Emails *must* be from your utoronto.ca email account (this is a UofT policy), and should contain all necessary information, including your lecture section and tutorial section.

Home page: <https://www.math.toronto.edu/ywyu/MATA02-2022-Winter/>

Quercus: <https://q.utoronto.ca/courses/246786>

Piazza: <https://piazza.com/utoronto.ca/winter2022/mata02>

Synchronous lectures:

- Monday, 9-10am, SW 309
- Wednesdays, 9-11am, SY 110

During the synchronous class times, I will lecture on the topic at hand. At various times during the lectures, I will require in-class participation. Participation forms a required part of your final mark.

Pandemic preparations: Should the lectures be moved online (as we already know they will for the first three weeks), a Zoom link will be provided via Quercus. Participation will still be required, and will be instituted through the Zoom chat functionality.

Tutorials/Quizzes:

- TUT0001: Tuesday, 9-10am, HW 308
- TUT0002: Friday, 9-10am, IC 120
- TUT0003: Wednesday, 4-5pm, HW 309
- TUT0004: Friday, 1-2pm, SW 319

There are two purposes for your tutorials; most tutorials will be spent reviewing the material covered in class and the unmarked practice problems you have been assigned. These tutorials will be run as hands-on practice sessions: your TA will introduce a problem, and then you’ll break up into small groups to work on the problem, before coming back together as a tutorial to go over the solution. The TA will circulate among the groups as you’re working to make sure you’re on track. **Practice session tutorials are optional.**

During five of the tutorials (marked on the course calendar), however, there will be quizzes covering recent material. To ensure fairness, I will always write at least five similar but distinct quizzes. One of them will be a practice quiz I publish in advance. The other four will be the

quizzes for each of the tutorials. i.e. the four tutorials will not receive the same quiz, but there will be no advantage for the Friday tutorial knowing the content of the Tuesday quiz, because the format will be the same as the practice quiz. **Quizzes are of course required, NOT optional.**

Pandemic preparations: Should the tutorials be moved online (as we already know they will for the first several weeks), a Gather.Town link will be provided for the practice session tutorials, with virtual breakout spaces and whiteboards, and the class Zoom link will be used for proctoring online quizzes (see details below about online assessment proctoring).

Office hours:

- Yun William Yu: Wednesdays, 11-12pm
- Ti Zhang (Mona): TBD
- Rick Cheng: TBD
- Yinuo Wang: TBD
- Yun Da Lin (Jamie): TBD

Overview

This course is intended for students with no background in mathematics beyond grade 10. The course will explore what numbers are. We will follow a path that begins with divisibility and leads to the fascinating topic of prime numbers and their mysteries. The payoff of the course will be the striking application of RSA encryption, a form of encryption generally used to secure transactions on the internet. We will go on to look at rational numbers and real numbers. This will force us to consider what we mean by saying that these are “infinite” sets of numbers, and why there are “more” real numbers than rational numbers.

Topics

What is a number? Numbers and lengths, visualizing numbers on the number line; Divisibility, Euclidean algorithm; Clock arithmetic: congruences; Divisibility tests; Prime numbers: Eratosthenes sieve, how many are there, how are they distributed; RSA encryption; Rational numbers, real numbers.

Requirements

For the quizzes and tests, you will need to have a standard hand-held calculator with no capacity to store text (that is to say, cell phones and graphing calculators are not allowed). If need be, you can ask your TA or instructor if your calculator is approved to be used on the test. You will be allowed ONE such calculator during the writing of assessments.

Pandemic preparations: If things are moved online, students must additionally have desktop/laptop, working microphone, access to reliable internet, a webcam, and the ability to draw diagrams/write math by hand (either through a scanner, camera, or tablet). The microphone and webcam are essential for online quizzes/exams because invigilation will be via Zoom in that eventuality.

Learning Outcomes

1. **Mathematical thinking**

You will learn about how mathematicians think about problems. What kinds of general principles underlie mathematical thought?

2. **Basics of number theory**

You will learn the basics of what numbers really are, and how this understanding of numbers enables modern internet security.

Textbooks

- *The Magic of Numbers* by Benedict Gross and Joe Harris. 1st Edition. ISBN: 0131777211. ISBN-13: 978-0131777217.
- Optional supplement: *Inspiring Mathematics: Lessons from the Navajo Nation Math Circles* by Dave Auckly. 1st Edition. ISBN: 1470453878. ISBN-13: 978-1470453879
- I will also be posting all of my lecture notes on the class website.

Lectures, Notes, and Recordings

Lectures will have a participation component. Your participation in class is required, and will form a part of your overall mark. The form of participation will vary depending on the format of the class (i.e. participation may be very different online than it is in person). After class, I will be posting my lecture notes to the class website.

Pandemic preparations: For online lectures, I will also post a recording of the lecture to YouTube. The recording will only be of my video feed and will not include your video/audio/chat. Thus, even if you turn on your video/audio (which I encourage), you do not need to worry about it being recorded. **Note: in-person lectures will probably not be recorded, as the WebOption folks are overwhelmed.**

However, if the exams and quizzes are invigilated online via Zoom, you will be required to have your webcam on and angled to include both you and your writing surface. The exam and quizzes (including the videos of the students) will be recorded for internal use; they will not be posted anywhere.

Evaluation and Grades

- *30%: Three hour final exam during final exam period*

Date: To be determined.

The final exam will be cumulative, but will focus on the material covered in the second half of the class (after the midterm). You will be allowed to use one handheld calculator with no capacity to store text, but no other aids. We expect the exam to be in-person. If due to public health reasons, the exam is moved online, then the exam will be conducted live and invigilated via webcam on Zoom, to be submitted via Crowdmark.

- *30%: Three hour out-of-class midterm*

Date: To be determined.

There will be an out-of-class midterm around midway through the term. You will be allowed to use one handheld calculator with no capacity to store text, but no other aids. We expect the midterm to be in-person. If due to public health reasons, the midterm is moved online, then the exam will be conducted live and invigilated via webcam on Zoom, to be submitted via Crowdmark.

- *20%: Quizzes*

There will be 5 quizzes during certain tutorials. You will be required to be in your registered tutorial for these quizzes. Depending on the quiz and logistical concerns, the quiz may take less than the entire 50 minutes, but certainly will not go over (with the exception of Accessibility-related extra-time accommodations). You will be allowed to use one handheld calculator with no capacity to store text, but no other aids.

If you do better on the final exam than on your worst quiz mark, I will automatically replace your worst quiz mark with the mark you received on the final. Note that this includes the scenario where you missed a quiz and got a 0 for that quiz. Thus, you may miss a single quiz effectively without penalty (the weight will simply be shifted to the final). This replacement is only for a single quiz, however.

Should you have a documented reason for being unable to attend one of the quizzes, please contact the instructor by email. In exceptional circumstances (such as with an officially documented excuse), the instruction team may at our discretion offer you the ability to take the quiz with one of the other tutorials. Otherwise, you will have to take a 0 for that quiz (though the first 0 can be replaced with your mark on the final, as stated above).

- *5%: Participation mark.*

Participation is required for the lectures. The format of the participation may vary depending on the delivery format of the lectures. Participation in online lectures will be via the chat functionality, but participation for in-person lectures will depend on the topic at hand.

Participation on the Piazza is not required, but it is encouraged. Similarly, participation in tutorials is strongly encouraged, but not marked.

- *15%: Assignments.*

There will be 5 marked assignments to be turned in via Crowdmark on dates specified in the calendar. Every student is given one late assignment token that can be redeemed for a 1 week extension on a homework assignment; use it wisely.

Note that collaboration is encouraged on the assignments, but you must document and cite any sources or classmates you consult. i.e. if a friend helps you with a problem, please write their name down. If you found a tutorial for the solution online from a non-class resources, please mention the website, etc. So long as you document your sources, you are encouraged to collaborate and find alternate resources!

- *0%: Suggested problems and practice quizzes.*

I may assign suggested problems or give out practice quizzes. These are unmarked, but may be discussed during tutorial. I strongly suggest you practice using them because some of the problems on the quizzes will be similar in scope and content.

- *+5% bonus: creating a pop-math YouTube video presentation*

You may earn up to an extra 5% for creating a pop-math public YouTube video on topics related to the class. You may work on the video in groups of up to 3. Please be sure to run topics and groups past the instructor by week 9. Note that I will be marking the videos for extra credit, so a mediocre video may only get 1% extra, whereas an exceptional video will receive a full 5% bonus.

Policy on missing midterm

If you miss the midterm test because of the following reasons: severe illness, injury or accident, family catastrophe, religious obligations, or legal obligations, you must (a) notify the instructor

by email no later than 48 hours from the ending of the test and (b) submit appropriate documentation where required by UTSC. Bear in mind that documentation requirements have been shifting with the pandemic, so we require only whatever UTSC does; as of the writing of this syllabus, students only need to submit an absence self-declaration form via Acorn < <https://www.utsc.utoronto.ca/registrar/acorn-absence-declaration-tool>> and do not need to get a physician's note.

The following reasons will not be considered valid excuses for missing the midterm test: work obligations, vacation leave, being out of country, extra-curricular activities such as sports or clubs, misreading the time of day or location, lateness, timetable or other test conflict, other course conflicts, traffic or other transportation issues.

Should you be excused from the midterm, you will receive the average of your quiz and final exam marks (weighted according to above, so you will receive $\{2*[\text{quiz average}] + 3*[\text{final exam mark}]\}/5$); should you not be excused, you will receive a 0.

Piazza

If you have a question, chances are someone else in your class does too! As such, for general questions, we prefer that you communicate through the class forums online. Sometimes, other students will be able to answer your question. The teaching staff will also regularly check the online forums, and this will ensure that your classmates can also read the answer.

Piazza: <https://piazza.com/utoronto.ca/winter2022/matao2>

Quercus Info

This course uses the University's learning management system, Quercus, to post information about the course. This includes posting readings and other materials required to complete class activities and course assignments, as well as sharing important announcements and updates. The site is dynamic and new information and resources will be posted regularly as we move through the term, so please make it a habit to log in to the site on a regular, even daily, basis. To access the course website, go to the U of T Quercus log-in page at <https://q.utoronto.ca>. Once you have logged in to Quercus using your UTORid and password, you should see the link or "card" for MATAO2H3. You may need to scroll through other cards to find this. Click on the MATAO2H3 link to open our course area, view the latest announcements and access your course resources. There are Quercus help guides for students that you can access by clicking on the "?" icon in the left side column. SPECIAL NOTE ABOUT GRADES POSTED ONLINE: Please also note that any grades posted are for your information only, so you can view and track your progress through the course. No grades are considered official, including any posted in Quercus at any point in the term, until they have been formally approved and posted on ACORN at the end of the course. Please contact me as soon as possible if you think there is an error in any grade posted on Quercus.

Accessibility Statement

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the AccessAbility Services as soon as possible.

Accessibility Services staff (located in Rm SW302, Science Wing) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations. You can

reach them by phone at 416-287-7560 or email ability@utsc.utoronto.ca. The sooner you let us know your needs, the quicker we can assist you in achieving your learning goals in this course.

Religious Accommodation

The University has a commitment concerning accommodation for religious observances. I will make every reasonable effort to avoid scheduling tests, examinations, or other compulsory activities on religious holy days not captured by statutory holidays. According to University Policy, if you anticipate being absent from class or missing a major course activity (like a test, or in-class assignment) due to a religious observance, please let me know as early in the course as possible, and with sufficient notice (at least two to three weeks), so that we can work together to make alternate arrangements.

Academic Integrity

The University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters (<http://www.governingcouncil.utoronto.ca/policies/behaveac.htm>) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences in papers and assignments include using someone else's ideas or words without appropriate acknowledgement, submitting your own work in more than one course without the permission of the instructor, making up sources or facts, obtaining or providing unauthorized assistance on any assignment. On tests and exams cheating includes using or possessing unauthorized aids, looking at someone else's answers during an exam or test, misrepresenting your identity, or falsifying or altering any documentation required by the University, including (but not limited to) doctor's notes.

Privacy/FIPPA Statement

Personal information is collected pursuant to section 2(14) of the University of Toronto Act, 1971, and at all times it will be protected in accordance with the Freedom of Information and Protection of Privacy Act. Please note that this course requires presentations of one's work to the class in tutorial, and if you choose to do the optional bonus video, that will have to be public. For more information, please refer to www.utoronto.ca/privacy.

Harassment/Discrimination

The University of Toronto is a richly diverse community and as such is committed to providing an environment free of any form of harassment, misconduct, or discrimination. In this course, I seek to foster a civil, respectful, and open-minded climate in which we can all work together to develop a better understanding of key questions and debates through meaningful dialogue. As such, I expect all involved with this course to refrain from actions or behaviours that intimidate, humiliate, or demean persons or groups or that undermine their security or self-esteem based on traits related to race, religion, ancestry, place of origin, colour, ethnic origin, citizenship, creed, sex, sexual orientation, gender identity, gender expression, age, marital status, family status, disability, receipt of public assistance or record of offences.